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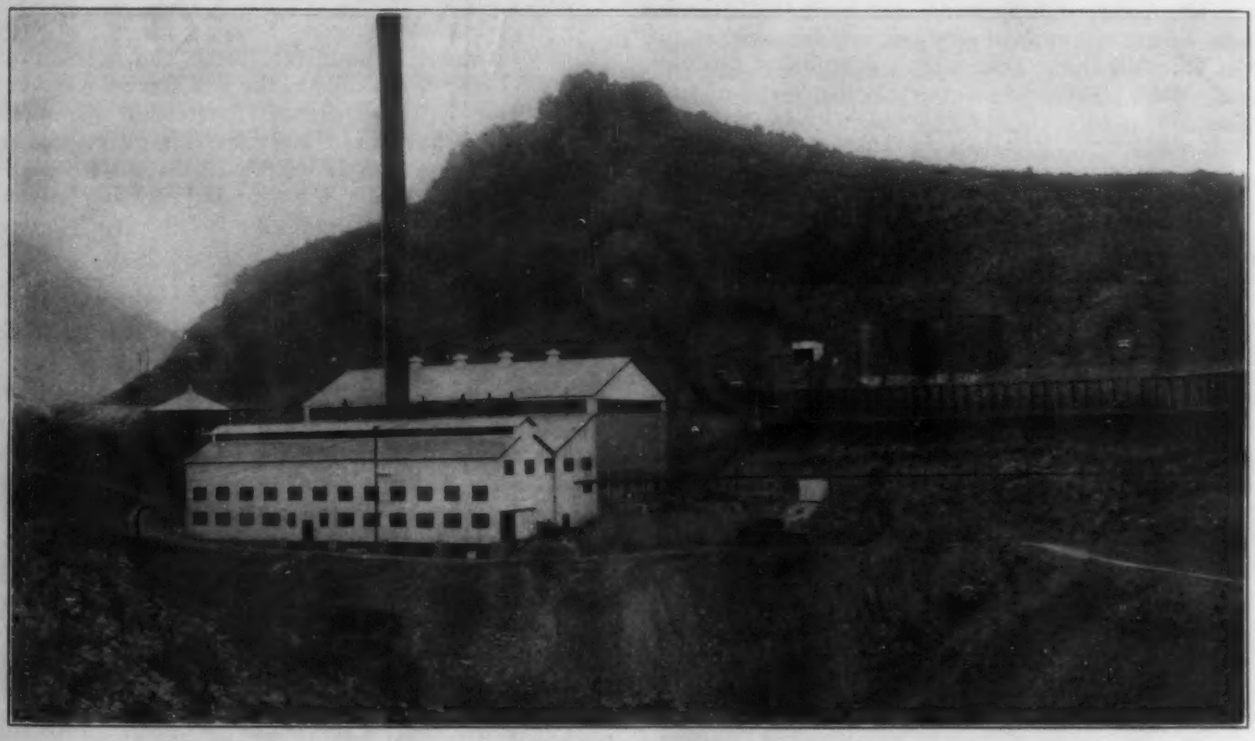
ELECTRICAL EQUIPMENT OF COPPER QUEEN MINE

BY WALTER CREASEY.

Electricity is an important factor in the operations of the Copper Queen mine at Bisbee, Arizona, one of the greatest copper producers of the world. In addition to a complete underground electric haulage system, electric power is utilized in the operation of conveyers, machine shops, pumps and small hoists.

Three-phase alternating current is supplied at 2300 volts, 60 cycles by three 500 kw. Curtis vertical steam turbo generators operated at 1800 r.p.m. Direct current at 125 volts is furnished by a 25 kw. Westinghouse motor generator set taking 2300 volts on the a.c. side, and at 250 volts by two 150 kw. General Electric



Copper Queen Central Power Plant

The company generates its own power at the central plant illustrated herewith, transmitting at 2300 volts to the various points of utilization. The prime mover is steam which is obtained from five 500 h.p. Stirling boilers equipped with Green economizers and superheaters and burning oil. Feed water is supplied by two electric pumps, driven 25 h.p. 250 volt d. c. Westinghouse variable speed interpole motors, and by auxiliary Dow steam pumps,

rotary converters, the latter being for the mine haulage system.

Compressed air for the hoists and drills is supplied from two Ingersoll compressors each of 3000 cu. ft. capacity, and one Nordberg compressor of 7000 cu. ft. capacity.

The main switchboard consists of three generator panels and 16 feeder panels, all feeders being metered at the switchboard by General Electric and Sangamo

Interior View Copper Queen Power Plant

meters. The voltage is regulated by a Tirrill regulator.

Underground Haulage.

The Copper Queen mines are equipped with nine miles of underground trolley construction, direct current supplied from the rotary converters at 250 volts being used. There are eleven electric locomotives in operation, eight 3-ton and two 6-ton Goodman and one 7-ton locomotive designed by the mining company and equipped with two Westinghouse 35 h.p. motors,

Mine Haulage System Showing Trolley Construction

using series parallel control. All the locomotives are equipped with connecting plugs so that they can be run tandem.

The trolley construction has been put in in a most substantial manner. The wire is supported from 4 by 6 timbers suspended from the top of the drifts by means of one-inch round bolts split-wedged into holes drilled into the top of the drift. The spans are from 50 to 75 ft. except on curves where from 10 to 20 ft. with pull-overs are used. The trolley wire is put up 6 ft. 10 in. above the rail using 26 lb. rails on a 20 in. gauge.

Experiments are now being made on storage-battery-operated locomotives, using the new Edison type A6 battery, 150 cells to the one three-ton locomotive. The batteries are accommodated by special trucks which have been built for this purpose. The mine haulage system is very hard on battery equipment, the solution spraying over and shorting between the cells.

Pumping.

The pumping plants at the three different shafts are all operated electrically. On the 400 level of the Czar shaft are three 300 gal. Allentown geared pumps, with 50 h.p., 220 volt General Electric motor; one 100 gal. and one 50 gal. Allentown pump. A part of the water from this shaft is used for the central power plant boilers, but as most of the water contains a large percentage of acid, it cannot be used for this purpose.

In the Spray shaft on the 900 level are installed two 100 gal. Allentown pumps, equipped with Bullock 20 h.p. 220 volts a.c. motors. Lowell shaft, 1400 level, consists of two 100 gal. Allentown 50 h.p. General Electric 220 volt motors. Sacramento shaft, 1700 level, consists of two 50 gal. Allentown pumps, with 15 h.p. General Electric variable speed a.c. 220 volt motors.

These pumping plants are very efficient installations. Tests are being made every few months which show an average of 78.6 per cent efficiency from the motor input to the water delivered to the surface.

All feeders to the pumping plants are run directly from the power plant, no other service feeding from them. We have found this a very important factor in case of trouble on lines, etc., where the sump room is limited and cannot allow of high water.

On large pumping plants, transformers are installed at the pumping station underground.

Mine Wiring.

All feeder wires installed in the shafts are three conductor rubber covered, leaded and steel armored cables, the steel armor being grounded. The high tension cables carry 2300 volts; the low tension 220 volts. All low tension cables for lighting service are rubber covered steel armored. We are using both steel armored rubber covered and varnished cambric cables. The varnish cambric cables have given by far the best service and I consider them far superior to rubber covered wire for mine work.

Mine Bell System.

For the mine bell system ordinary bell rope is being used for hoisting and lowering men. Electric bell signals have not been considered safe for this purpose. Electric signals are used for calling the cages to the stations. For this purpose an individual reset annunciator system is being used, so that each call is registered and when answered can be reset individually, leaving the remaining unanswered calls registered. This system has given perfect satisfaction to the mine department and the cost of its maintenance has been very small. This system is installed at each shaft and put in No. 18 rubber covered leaded cables, using Hargis cable splicing boxes. Twin leaded cable has been used from splicing boxes to the pull switches. The switches for operating the annunciator are by no means a push button, as it is necessary to have something very substantial for this class of work, the miners not being very good at operating push buttons. These switches consist of a heavy constructed socket with strong coil spring behind the plunger contactor and incased in a cast iron box, built for heavy duty, and have given good satisfaction.

Telephones.

The intercommunicating telephone system has been tried out through a part of the mine, but due to the dampness and the heavy cost of maintenance, together with the small amount of benefit derived, it has not been considered efficient equipment.

An automatic telephone equipment is installed through the Copper Queen Store Department. This has proven of great advantage to the store service.

The electrical apparatus of the Copper Queen Store, consists of three Otis freight elevators, one 20 h.p. Bullock motor running refrigerating plant, one 10 h.p. General Electric 220 volt motor, operating the pneuamtic tube system and one General Electric 50 h.p. motor generator set for arc lighting, together with various other motors for coffee mills, etc.

Examination for hydroelectric engineers in the forest service is announced by the United States Civil Service Commission on November 9-10, 1910, to fill two vacancies at San Francisco, Cal., at $2100 and $2400 per annum, and vacancies requiring similar qualifications as they may occur in that service at salaries ranging from $2100 to $3000 per annum, depending chiefly upon the character of the training and experience of the eligibles. The examination will consist of plane surveying, 5 credits; general hydrology, 5 credits; river hydraulics, 10 credits; water-power engineering, 15 credits; electrical engineering, 15 credits; general and technical training and experience, 50 credits.

ROTARY CONDENSERS AND INDUCTION GENERATORS ON TRANSMISSION SYSTEMS.[1]

BY A. L. JONES.

The development of the electric art seems to proceed by waves, one machine after another being elevated to a peak of popularity, and at its peak seeming to have a place and an importance in the electrical field, which makes us wonder how we were able to get along without it before. Just now the extensive use of motors of the synchronous type is attracting considerable attention. The reason is easily found and follows as a result of the increasing importance with which the question of power factor is regarded. The non-synchronous generator while attracting less attention, seems by virtue of its characteristics to offer a solution of some transmission line troubles, and is therefore of interest.

Rotary Condensers.

A characteristic of the synchronous motor most useful to transmission systems is its ability to operate at a power factor under control of the operator. The influence of power factor loads on both generator and transmission systems is being felt more and more keenly as systems are loaded with induction motors.

An induction motor, since it consists of copper conductors linking a magnetic circuit, requires a magnetizing or exciting current, the extent of which is fixed by the design of the motor, and is practically constant in value for all loads. This magnetizing current is practically wattless and lags nearly 90 degrees behind the line pressure. An induction motor running light takes its full magnetizing current and a small amount of power current to overcome friction and windage and supply the copper and iron losses. Under such conditions the magnetizing current has its full value, while the power current is very small. The power component is but a small portion of the current input and, therefore, the power factor of the motor under such conditions is extremely low. As the load is increased, the current which flows to supply the work done by the motor is a larger and larger portion of the total current input with a consequent increase in motor power factor. It is evident from the above that a fully loaded induction motor has a better power factor than one that is partially loaded. It is also evident that the power factor of such a motor can never be unity, since the wattless magnetizing current is always present.

All motors require a magnetizing current. Synchronous motors receive their magnetization from an external direct current source, whereas induction motors have no other source of excitation than the alternating current system feeding them. The generators automatically supply excitation for the motors unless other means are provided. The magnetizing current is wattless and while it is circulated with the expenditure of no energy beyond the extra copper losses due to increased currents, it has the bad effect of using up the capacity of the generators with current from which no useful work can be obtained. The out-

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[1]Read before the Colorado Electric Light, Power and Railway Association, at its eighth annual convention, held at Glenwood Springs, Colo., September 21, 22, 23, 1910.

put of the generator is limited to the amount of current it will carry without injurious heating, and naturally, if part of this current is wattless, the full power rating of the generator cannot be realized. The actual energy available from generators carrying their full rated current is shown by the power factor at which it is operating; thus, a 1000 kw. generator at 70 per cent power factor can deliver but 700 kw.; 30 per cent of its capacity and of that of its prime mover being unavailable.

The extra field current required to maintain the voltage of a generator supplying an inductive load, increases the field losses and may result in dangerous heating, or even call for a voltage beyond the range of the exciter. This extra field is active in circulating the wattless current demanded by the load. The inherent regulation of both generator and transmission line is demoralized by the circulation of the wattless current and poor service results.

When two or more generators are operating in parallel, supplying an inductive load, the necessary magnetizing current may be supplied by operating all the generators at the power factor of the load, in which case each unit bears its proportionate share of the wattless current, or some of the generators may have their fields increased, which results in their carrying more than their share of the magnetizing current and relieving the other generators by the same amount. The over excited generators operate at a power factor less than that of the load, while the power factor of the others is higher than the power factor of the load. By adjusting the field current of one or more of the generators to a value which reduces the armature current to a minimum, we make this generator operate at 100 per cent power factor, while the others carry the wattless current dropped by this machine, and have a power factor much lower than the load. Of course, the best arrangement is to operate all the generators at the power factor of the load and to let each take its proportionate share of the wattless current. In cases where one or more of the generators have fields more liberally designed than others, it is but right that these machines should take a larger proportion of the wattless current. Unless there is some other synchronous apparatus on the line, there is no way of relieving the generating equipment of this magnetizing current.

A synchronous motor on the system has its excitation provided from an external d.c. source, and should, therefore, require none from the line. This is the case, provided a field current of the right value is provided, in which case, the motor operates at unity power factor. If the field is weaker, the extra excitation is provided by a lagging current drawn from the line, which has the effect of assisting in magnetizing the field poles to the proper intensity in a manner similar to the magnetizing action of lagging current taken by an induction motor. If, on the other hand, a greater field current is provided than that which gives unity power factor, a leading current flows which has the effect of partially demagnetizing the field poles, resulting in the proper value of magnetization. Another way of regarding this would be to consider that the excessive field of an over-excited synchronous motor is translated into alternating current excitation available to partially supply that required by the various induction motors on the system. The effect of an over-excited synchronous motor is, therefore, to act as a generator of magnetizing current. This is wattless, so that a synchronous motor running idle, with over-excited fields, requires no power to drive it, beyond that to overcome friction and windage and to supply the iron and copper losses.

Motors used in this way are called rotary condensers and are coming to play a more and more important part in the operation of large power systems.

While it is perfectly practicable for the generating equipment to supply the magnetization required by an inductive load, the rotary condenser affords a cheaper and better way. The generators are frequently slow speed units with heavy engines and large boiler and condensing plants. It has been shown that the wattless magnetizing current renders part of the capacity of the generator unavailable, and at the same time the engine and boilers are but partially utilized, and the investment of the unused portion lies idle. Moreover, if this wattless current can be generated near the place where it is to be used by the inductive load, it will save large line losses and greatly improve line regulation.

A rotary condenser can be a high speed machine and be so designed that a given amount of material will give much greater k.v.a. output than is possible in the case of a generator. The net result is that a given amount of wattless current can be provided from a synchronous condenser at a much less cost than if the generating equipment is left to provide it.

The operating engineer supplying loads at low power factor has this system of supplying excitation forcibly presented when his plant reaches its limit in current, and consequently in output; while his prime movers are far from fully loaded, and the energy he is selling considerably less than the rating of his machines. He faces the necessity of purchasing more generating equipment with its prime movers and complicated accessories, or a less expenditure for a rotary condenser. The latter costs but a fraction of the former.

If he desires to install such a device, the proper location presents an interesting and important question. Since the rotary condenser is to provide magnetizing current to the inductive load, it follows that the nearer this machine is placed to the center of the load, the less distance the wattless current will have to be transmitted. If the condenser is placed in the power house, the generator will be relieved of wattless current, but this will have to be carried to the load through transformers and lines and will benefit the generator alone, while if placed as near the center of distribution as possible, it relieves generators, lines, step-up and step-down transformers of the wattless current.

When deciding on the size condenser to use, it is well to bear in mind that such a machine can also drive a mechanical load without greatly reducing its capacity as a condenser. The power component required to supply this mechanical load is at right angles to the wattless component, so that the total current, which is of course the limiting feature, is but little increased. A mechanical load of 20 or 30 per cent of its rating can be carried by a given synchronous motor, and the capacity of the machine, as a condenser, be

lowered but three to five per cent. A rotary condenser will drive 70 per cent of its rating in mechanical load and at the same time produces 70 per cent of its rating in wattless magnetizing current. It is thus seen that by sacrificing 30 per cent of its capacity as a condenser, we have available 70 per cent of its rating for use for mechanical work. It follows from this that when buying a synchronous motor to do a piece of work, the selection of a machine 30 per cent larger than necessary will permit the production of 70 per cent of its rating in magnetizing current, and relieve the generating equipment, lines, etc., by this amount.

In general, no attempt should be made by means of a rotary condenser to raise the power factor of the system much above 95 per cent. This is due to the fact that a given amount of wattless current introduced into a system is much more effective at low power factors than at high. Suppose a system operating at 70 per cent power factor and with the generators supplying all the magnetizing current. If they are carrying full current, 30 per cent of their capacity is usurped by the wattless current. The supplying of a certain amount of wattless current from a condenser will raise the power factor to 95 per cent and thus redeem 25 per cent of the generator capacity. To raise the power factor to 100 per cent and thus realize the full capacity, would require approximately double the condenser output mentioned, and the additional capacity gained would only be five per cent. From this case the force of the first statement in this paragraph is apparent.

The amount of wattless current given out by a rotary condenser is easily adjusted by the field, and hence a given condenser can be used to correct the power factor of a system under varying loads and power factor conditions. By means of a Tirrill regulator, a constant power factor can be maintained on the transmission line at the point of installation of the condenser, or it can be arranged to hold a constant potential regardless of the load or power factor of the line, the regulator changing the field current and drawing over the line leading or lagging current in such quantities as will act with the line constant to give a uniform voltage.

Mechanically the synchronous condenser resembles the familiar revolving field synchronous motor, but is equipped with a lighter base, shaft and bearings, if it is to supply no mechanical load. The pole faces of the field are equipped with copper bars which are connected on the ends by short-circuiting rings, similar to those of the squirrel cage induction motor. This short-circuited winding aids in starting and prevents hunting. Starting is easily accomplished by supplying a reduced voltage to the armature by means of a compensator, the field circuit being open to prevent injury to the field windings by current which would be circulated by the high induced potential. After the machine has reached full speed, which requires twenty to thirty seconds, the field switch is closed and the full potential thrown on the motor. The current drawn from the line at starting and the time to come to speed are approximately the same as required by an unloaded squirrel cage motor of the same rating.

I have endeavored to show that all inductive loads require a wattless magnetizing current which is usually supplied by the generating equipment; but that this method of tying up expensive machinery is undesirable; and that the rotary condenser offers a cheaper and better way of supplying this current, and permits the supplying of excitation at the exact point where it is needed. The use of synchronous motors in a transmission system should be encouraged, and these should be 30 per cent greater capacity than necessary and the extra capacity used to produce wattless magnetizing current. That a rotary condenser with the addition of a regulator permits of automatic voltage regulation at the end of a long transmission line. The universal effect of the addition of a rotary condenser is to greatly improve the voltage regulation and give better general operating conditions in other respects.

Characteristics of the Induction Generator.

Certain difficulties, arising in the operation of synchronous generators, such as speed regulation, with the number of plants in multiple and difficulty of regulating the voltage between such plants, together with synchronizing difficulties, to say nothing of the simplicity and ruggedness of this type generator, make the operating engineer turn to this device as a possible solution of some troublesome operating conditions.

The characteristics of the induction motor are so well known that it is not necessary to refer to them here, beyond pointing out the action of this type of motor above and below synchronism. An induction motor as such always rotates at a speed less than synchronism, the difference between actual and synchronous speed being called the slip. It depends in a given case upon the load. The torque of such a motor is proportional to the product of the magnetic flux set up by the primary and the current in the short-circuited secondary, the latter current in turn depending on the flux cut by the conductors of the rotor, and hence on the slip. If an induction motor is called upon for a torque in excess of that which it is delivering, an adjustment at once takes place by the rotor slip increasing till the additional flux cut by the secondary conductors sets up a current in the short-circuited rotor, which is sufficient to produce the greater torque required. As the load is reduced to a minimum, the speed of the motor rises to nearly synchronism, the secondary current and the torque fall, and if the machine is driven at exactly synchronous speed, both become zero. The motor at all loads takes a certain magnetizing current, and this is present even if the rotor is driven at synchronous speed. If driven above it the rotor bars cut the primary flux in the opposite direction, resulting in a reversal of the secondary current and, therefore, of the torque. In other words, the machine requires mechanical power to drive it above synchronism and hence has become a generator.

The change from motor to generator is analogous to the action of a shunt wound motor when connected to a direct current source and driven above the speed at which it would operate as a motor. When driven in this manner the counter e.m.f. of the armature is higher than the impressed voltage and a reversal of current takes

place and the machine gives out energy, hence it becomes a generator. In the case of the induction motor, armature reaction is always present tending to weaken the primary flux. When such a machine is connected to a proper alternating current source and driven above the synchronous speed of such source, the rotor bars cut flux in the opposite direction, and a consequent reversal of current takes place in the armature. The armature reaction now aids the magnetization of the stator iron, where in the case of the motor it tended to weaken it. As the speed above synchronism is increased, the sum of the flux set up by the true magnetizing current drawn from the line, and that supplied by armature reaction of the rotor, tend to magnetize the stator iron to a density greater than normal. The iron of an induction motor, just as in a transformer, must operate at a practically constant density regardless of the load, and the tendency of the armature reaction to increase the flux causes a flow of current into the line. The current thus generated in turn demagnetizes the iron and maintains the flux at the proper value. There is a definite armature reaction for any given speed above synchronism, and it follows that there is a corresponding definite current output by the induction generator.

It is a fundamental characteristic of this type of generator that it cannot deliver leading or lagging current and can only supply power current to a circuit which can provide it with a wattless magnetizing current. For a given speed above synchronism, the amount of current it will deliver is fixed. These apparently rigid and inflexible conditions have in the past prevented the extensive use of this type of generator.

The power output of an induction generator depends upon the primary flux and secondary current, the latter, in turn, being dependent upon the speed above synchronism. The density of the primary flux in a given case is fixed by the voltage. Under conditions of short-circuits on the system, the voltage of the synchronous generators drops, with the result that the current producing power of the induction generator falls at the same time, due to the dying out of the primary flux, and such a generator, therefore, cannot supply current to a short-circuit. On large cable systems, and where a short-circuit involves a tremendous amount of power, this characteristic might be of great value. On a cable system, also, the charging current of the cables would partly supply the magnetizing current required by the induction generator and remove to some extent an objectionable feature of this type of machine.

High speed steam turbine work seems to be the most promising field for induction generators, since the simple mechanical construction of the squirrel cage rotor permits a high speed and high operating temperature without injury to the machine. It has also been proposed for gas engine work where parallel operation of synchronous machines is usually secured at the expense of heavy fly-wheels and elaborate damping devices on the pole faces, and where even with these, successful operation is not always possible. If instead of synchronous units, induction generators were installed having high speed synchronous motors running light to supply the excitation for the outside load and for the generators, there would be no necessity of limiting the angular variation of the gas engines to the present very exacting figures. Any demand for more load comes first on the synchronous motor, causing it to drop slightly in speed, with the result that the induction generators running at a constant speed would have their slip above synchronism increased and the load would be automatically transferred to the induction generators. The voltage of the system would be controlled by a regulator working on the direct current exciter of the synchronous motor.

The same arrangement has been advocated for water-wheel driven stations or a modification of it to the extent of having a number of wheels drive synchronous generators, and the remainder induction generators, thus doing away with hunting and exchange currents between the machines, and also with governors on the wheels driving the induction type generators. It might also have a place in the development of a stream where no storage was available, and where the plant is a part of a large system and must be cheaply operated. This station could be run without attendants by having an induction generator tied to the line and the water always turned on. The generator would run above the synchronous speed of the system till it took a load equivalent to all the water available. If the water supply should be interrupted, the induction generator would run on the system like an unloaded induction motor. If in any manner it were disconnected from the system, it would simply run at from 50 per cent to 70 per cent above the no load speed, and no harm would result.

If the synchronizing of an alternator is not perfectly done, an instantaneous rush of current results which is limited only by the resistance and the true reactance of the winding, and frequently reaches fifteen to twenty times normal value. The strains on shaft and windings may be many times normal and result in injury to the machine, or result in annoying delays due to opening of the switches by the heavy rush of current. With the induction generator, there is no necessity of synchronizing with the system, the induction machine being simply to run up the speed if thrown on the line in series with a reactive coil (reactive coil is then short-circuited) and the generator is automatically excited from the system and takes a load proportional to the power input.

In cases where the induction generator is used, the synchronous machine acts as an exciter supplying alternating magnetizing current. The volume of this wattless current, however, becomes so great that the induction generator cannot bear any great proportion to the capacity of the synchronous units, or the latter will be so loaded with wattless current that their capacity for useful work will be seriously reduced. For instance: an induction generator having a full load power factor of 90 per cent will require a wattless magnetizing component of 43½ per cent of the full load current, and if a case is taken where the synchronous generator is the same size as the induction motor and the combined output is supplied to a load having a power factor of 100 per cent, the power out-

put of the synchronous generator cannot exceed 87½ per cent of its rating, due to the heavy magnetizing current required by the induction generator. If the load were at 95 per cent power factor, all but 35 per cent of the capacity of the synchronous machine would be required to supply the magnetizing current of the load and the induction generator. If the power factor of the load is 90 per cent, but 6 per cent of the synchronous generator is available for useful work, and if the power factor of the load were 88 per cent, all of the current capacity of the synchronous generator would be required for magnetizing current of the induction generator and of the load.

In case the synchronous generator is twice as large as an induction machine, conditions are much better and are as tabulated below:

Power Factor of Load	Per cent Capacity of Synchronous Generator Available for Power Load.
100	97
95	75.2
90	62
80	39.9

If the combined induction generator capacity is one-fourth or less of the synchronous capacity, the wattless magnetizing current becomes an unimportant part, but by the same reasoning, the gain which such a machine effects, is also correspondingly reduced. A power factor of 90 per cent for full load for such a generator is perhaps a little low, but with machines of small size, and especially of slow speed, much better results would not be obtained. Turbine driven machines of 1000 to 3000 kw. capacity, and running at 1500 or 1800 revolutions, can be designed with a full load power factor of 95 to 96 per cent, and with such a machine the magnetizing current would not be such a drag on the system—though situations where generators of this size could be used would be relatively rare.

In trying to find why the induction type of generator has not been used to any great extent, we are confronted by a number of serious objections to this type of machine. It is distinctly a secondary and dependent piece of equipment, unable to function unless in connection with synchronous generators. It is unable to produce any wattless current, of which most modern systems require considerable. It requires such a large magnetizing current that the induction generator can bear but a small proportion to the capacity of the synchronous machines, and its good effects are consequently reduced.

While the simple mechanical construction should make the cost of such a machine less than that of the more complicated synchronous generator, heavy engineering and development charges will have to be borne by the first machines produced, which will probably make them cost more than the synchronous generators. There has been practically no demand for this type of generator, which shows that as yet the American power station practice does not consider that the advantages of the induction generator can off-set its many disadvantages.

MUNICIPAL INSPECTION OF GAS AND GAS METERS.[1]

BY WM. SCHADE.

Municipal inspection of gas and gas meters is by no means of recent date, neither is it an imposition upon gas men, nor an infringement upon their rights to conduct their own business to suit themselves, as many have and perhaps now suppose it to be. Municipal inspection is as old as the gas business itself, and a natural adjunct to the business.

In order to make myself clear and substantiate my position, I beg your kind indulgence in a brief review of the early history of the gas business. I sincerely believe there are many gas men now, perhaps members of this association, that are not at all familiar with the early struggles for the introduction of artificial gas as a commodity or public utility, and it may therefore be of interest to them.

England is undoubtedly the mother country of the discovery and practical application of artificial gas as a public utility, as well as to the regulation of prices for gas and the quality thereof. Nearly two centuries ago illuminating gas was first artificially distilled from coal in heated iron retorts, and the gas thus obtained was called "spirit of coal," but was never put to a practical use there (notwithstanding that a number of men experimented continuously with this process for about seventy-five years) until the close of the eighteenth century, when Mr. William Murdoch lighted his own house at Redruth in Cornwall with coal gas. Coeval with Mr. Murdoch's experiments were those of Mr. Lebon in France, who both lighted and heated his own house by this means, and also made his first exhibition of "light" in Paris in 1802. But it remained for England to make a public practical application of this great discovery, and through the untiring efforts of Mr. F. A. Winsor, one-half of Pall Mall, London, was lighted by gas in 1807.

The great advantage of gas light for streets and public buildings became apparent, and in the year 1809, Parliament was appealed to for an "act" granting permission to incorporate a gas company, which was granted in the following year. From the foregoing statements it will be seen that as early as 1809 Federal aid was enlisted by those who intended to enter the business of manufacturing and distributing gas for public use, which subsequent events proved to be a wise move, and while in consequence of this act many gas companies sprang into existence, frequently in such keen competition with each other that some of them almost went under, which was not to be wondered at, taking into consideration the absolute inexperience and the crude method of production, as well as distribution. As late of 1850 some companies' shares valued at $250 each could not be sold for more than $6.25. The outlook was indeed gloomy for some of these companies. Parliament was again appealed to, and under the pressure brought to bear upon the gas companies by this legislative body, amalgamation of many companies, as well as districting the territory, was speedily effected, which received the sanction of Parliament in 1860.

[1]Paper read at eighteenth annual convention Pacific Coast Gas Association, Los Angeles, September, 1910.

From this time on the use of gas as a commodity spread rapidly all over England, France, Germany and the United States of America.

Simultaneously with the assistance given the companies and the establishment of a fixed rate per thousand cubic feet of gas, guaranteeing a ten per cent profit on the investment, besides a suitable reserve, Parliament realized at once the necessity of also protecting the rights of the people, which it did without delay by creating a commission to be appointed by the "Board of Trade," whose duty it was to see that justice and equity prevailed between producers and consumers, concerning the rates to be charged for gas, and whenever the books of the companies showed an earning in excess of the guaranteed ten per cent and a suitable reserve, the rate per thousand feet was reduced; and so admirably did it work that in the course of twelve years the price of gas had been reduced from $3.75 to 93 cents per thousand feet. Parliament also appointed at the same time three "Gas Referees" (expert chemists) whose duty it was to make daily tests of the gas produced to see that the established standard of the illuminating candlepower and purity was maintained and strictly adhered to. The necessity for creating the position of municipal inspector arose principally from the fact that the effect of inhaling the impurities and the offensive odor accompanying the combustion of gas in the homes of people was so objectionable that it greatly retarded the introduction of gas. The science of chemistry of gas manufacture and purification was then in its infancy. It became imperative, therefore, that competent men should be placed in charge, independent of the companies, to see that the people received honest value for the honest dollar the government had asked them to pay the companies. This was not derogatory to the interests of the companies by any means, but the natural sequel of the then existing conditions, a decided advantage to all concerned and the only proper thing to be done. On the one hand, it saved the companies the employment of a chemist, the installing of a costly laboratory, and yet they knew at all times the exact condition of their gas. On the other hand, the people felt more secure in having their interests officially taken care of. This was soon recognized wherever gas was used and municipal inspection became universal in England. Birmingham, Manchester and other large cities adopted rules and regulations as early as 1864.

I do not wish to be misunderstood concerning the last two statements. I am highly in favor and heartily recommend that every first-class gas plant should have a laboratory, with a competent man in charge of it, and every gas manufacturer should urge in his respective community (for his own benefit if nothing else) the creation of the position of municipal gas and meter inspector. Not only can you check up the work of your own man with him, but you can also unload any amount of complaints upon his shoulders without cost, and the result is usually satisfactory, speaking from experience, and I believe it will receive the endorsement of all the representative men of the three companies operating in Los Angeles. I wish to state right here that municipal inspection of gas and meters is absolutely sane, logical and the proper thing to have, for the results are as far reaching in their benefits to the companies as they are for the public, and any man thinking otherwise should change his mind at once. In every well-regulated civilized country everybody expects either Federal, State or municipal inspection of every public commodity and we should encourage it here.

This, I think, will be sufficient on the municipal inspection of gas, and I will now take up the other part of the subject—municipal inspection of the gas meter.

Had I the tongues of men and of angels, or the gift of speech of the greatest orators the world ever knew, I would not dare to attempt to adequately describe the flow of language (profane and otherwise—mostly profane), the engendered feelings of hatred and passion, that this little innocent, inoffensive thing, "this outward monitor" of man's inward passion, is guilty of, this bone of contention, this bugaboo of all the bugaboos in the gas business, this "perpetual" motion machine, which according to public opinion fills the coffers of the gas man, obeying the will of its master, jumping up and down according to his needs and wants financially, and the amount the public can stand, this best and most faithful friend the consumer ever had, never affected by the misreadings of the man who reads it, never trying to wreak vengeance for the abuse it suffers; now it is exposed to the glaring, burning sun by day and the cold and chilling dampness of the night, then again it is tossed about under some shack sunk half way down into mud and slush; then again it is exposed to the sprinkling by the garden hose and made a target for stones thrown by mischievous neighborhood boys, and so forth and so forth; never occupying a decent place in the house of the consumer as it should, yet it is ever faithful, ever true, but because people do not know or understand the construction or operation of a gas meter they express their erroneous ideas according to their feelings. It is essential therefore, that somebody should educate the people on the gas meter and testing it when necessary, and what would be more proper than having a municipal inspector for this purpose?

In conclusion, I beg to say, that being conscious of the fact that however interesting, a paper may be too long, and thus becomes tedious, totally defeating the intentions of the writer. I have made but a brief reference to the history of gas lighting, as many of you have no doubt discovered. For instance: There was Von Helmont, the earliest experimenter in our business, and who first called his discovery "gheist" (ghost), or as I have translated it "spirit of coal"—hence our word "gas." Samuel Clegg, called by many "the father of gas making," and to whose inventions of various apparatus, (many of which are used to this day) among which is the gas meter almost as we have it now, we are greatly indebted, and many others you no doubt know of. In connection with this subject it may be permissible to remind you of the earliest successful American governmental gas inspection, viz: the "Board of Gas and Electric Light Commissioners of Massachusetts." The beneficent results of the labors of that commission has been so much appreciated by the people and by the corporations alike that at last it has caused the institution of similar bodies in other States; and thus I trust I have made good the main points as set forth in the title of this paper.

BOILER EFFICIENCY WITH OIL AS FUEL.

Tests have been recently made on the Canal Zone at Los Cascadas air compressor plant and at the Mount Hope pumping station to determine the economy and efficiency of the boilers, with California crude oil as fuel. These tests are similar to those made at all the large boiler plants in the Canal Zone, a summary of which was published in the Journal of Electricity, Power and Gas of July 2, 1910.

At Las Cascadas, the test was made on six return fire-tube boilers, and consisted of two trials of 7½ and 9 hours, respectively. The first trial was made while the plant was operating under normal running conditions, while during the second, an attempt was made to increase the economy and efficiency by decreasing the amount of air supplied to the furnace for combustion, closer regulation of the oil and steam used by the burners, and by operating the boilers at their full rated horse-power. The second trial showed an economical adjustment of the burners (two to each boiler), which was verified by the high evaporation of water per pound of combustible, and very little improvement could therefore be made in this respect. The increase in economy was obtained by decreasing the amount of air supplied to the furnace for combustion, by closing the ash pit doors and dampers, and by operating the feed water pump at a constant speed, keeping about one and one-half gages of water in the boilers throughout the test. Some results of the test are as follows:

	Trial 1.	Trial 2.
Horsepower developed	1,442.58	1,507.82
Equivalent evaporation from and at 212 degrees F. per pound of oil....lbs.	13.931	14.404
Equivalent evaporation from and at 212 degrees F. per pound of combustible....lbs.	14.154	14.635
Cost of fuel for evaporating 1,000 pounds of water under observed conditions.....	$0.2528	$0.2437
Cost of fuel for evaporating 1,000 pounds of water from and at 212 degrees F.....	$0.2365	$0.2287

At Mount Hope the test was made on one locomotive type boiler, the first trial being to determine the economy and efficiency under normal running conditions. A comparative trial was then made for the same length of time (16 hours), to see if an increase in economy could be obtained by decreasing the amount of air supplied to the furnace for combustion, carrying a boiler pressure of about 80 pounds gage, 1½ gages of water, and by closer regulation of the oil and steam used by the oil burners. The results of the second test show that a considerable increase over the first test, both in efficiency and economy, was obtained, principally by decreasing the supply of air to the furnace, close regulation of the oil burners, and carrying a higher boiler pressure. The results for the test were as follows:

	Trial 1.	Trial 2.
Horsepower developed	77.96	86.87
Equivalent evaporation, from and at 212 degrees F., per pounds of fuel, as fired..lbs.	10.75	13.11
Equivalent evaporation, from and at 212 degrees F., per pound of combustible....lbs.	10.99	13.40
Cost of fuel for evaporating 1,000 pounds of water under observed conditions.....	$0.3365	$0.2759
Cost of fuel for evaporating 1,000 pounds of water from and at 212 degrees F.....	$0.3064	$0.2513

OIL OPERATIONS IN MEXICO.

During the last few years this section has been explored by expert engineers and geologists, with the result that it has become generally understood that the Gulf coast of Mexico has great possibilities as an oil field. Over a score of companies, including the largest and most powerful oil interests in the world, have been engaged in the work of exploring and develing; millions of dollars have already been spent; hundreds of dollars worth of machinery has been imported for this purpose; a small army of engineers, geologists, and drillers has been kept busy.

Until recently the only success obtained in this field in the immediate vicinity of Tampico was that of the Mexican Petroleum and Development Company in what is known as the Ebano field, about 35 miles from Tampico. The Pearson interests developed some wells in the Veracruz district, and had some little success in the Tuxpam region. During the last few months the Huasteca Oil Company met with some success in the Juan Casianos field, and recently the Mexican Fuel Oil Company brought in a well at Topila. During July, 1910 the East Coast Oil Company, representing the Harriman interests, were successful with a well at Topila and another at Panuco, As a result of these successes, the value of leases has increased greatly.

The companies already operating in this section include: The Mexican Petroleum Company of California; the Huasteca Petroleum Company, owned by the Doheny interests and an allied company of the Mexican Petroleum Company of California; the East Coast Oil Company, which has as yet no corporate existence, but which represents the Southern Pacific or Harriman interests; the Mexican Fuel Company, a Waters-Pierce Oil Company concern; the Mexican Fuel Oil Company, incorporated under the laws of West Virginia; the Dos Banderos Oil and Gas Company, an Arizona corporation; the American International Fuel and Petroleum Company, which was organized under Delaware statutes; a California corporation, the Tampico Petroleum Company; the Standard Oil Company of Mexico, with home offices in London; the Standard Oil Company of England, with the same official personnel as the preceding company; the Hidalgo Petroleum Company, composed of California parties; the Tampico Oil Company (Limited), an English organization. The operations of S. Pearsons Sons & Co. have been very extensive.

The Electra Petroleum Company is being formed, under English law, to develop leased land near Juan Casianos. A company is organizing in California for work on a hacienda 20 miles up the Panuco river from Tampico, and a Salt Lake City company, which has a fruit farm near Caracol, has oil-drilling machinery on the way for sinking a well about 15 miles from Tampico

Each day is bringing new developments. Outside of the fact that a number of companies had to cease operations until the close of the rainy season, the prospects are brighter than they have ever been before, and it is confidently expected that the Gulf coast will shortly become a great producing field.

THE PUBLIC SIDE OF STREET RAILROADING[1]

BY PATRICK CALHOUN.

No men, not even those engaged in public life, come in such close contact with the people of the cities as those who manage their daily transportation. From this contact we learn an important fact—the utter indifference of the general public to what may be termed the private side of street railroading. How many of the general public do you find who understand the tireless energy, the constructive genius, the wasted experiments, the tremendous labor which have been required to develop the art of electrical transmission necessary to propel economically a street car? How many who realize the vast sums expended during the past 25 years in constructing, first, the horse-car lines; their conversion into cable lines, and then the conversion of the cable lines into electrical lines; or the amount wasted in abandoned electrical machinery? And yet, many modern, up-to-date railroads represent the entire cost of these successive stages.

Theoretically, the public side of the question should be confined to these propositions:

(1) That the complicated machinery and organization of a street railroad system shall result in cheap, first-class and efficient service.

(2) That the best methods of granting the use of streets for transportation purposes shall be adopted, and full payment be made for such use.

(3) Whether a higher return for the use of the streets and a better and more efficient street car service thereon can be more cheaply obtained through public than through private operation.

These propositions involve non-political questions of a business nature. Their discussion should create no heat and arouse no rancor. All classes are interested in their correct solution. In every city of the country the problems of street railway transportation are receiving the attention of the most skilled and competent men, yet, no questions affecting our city life have created more virulent, demagogic attacks, have been discussed with less intelligence or more bitterness. The politician, the yellow journal, and the muckraker have combined to misrepresent the position of the railroads. Managers and owners are falsely charged with being the chief source of corruption in city government, and the effort is being made to separate them from the balance of the community. They are denounced as the enemies of society. The result of these attacks has been in a notable instance, in the city of Cleveland, to throw a perfectly solvent, splendidly managed property into the hands of receivers; to make many conservative investors fearful of the future of the securities of street railroads, and to place such securities in the speculative, instead of in the investment class, where they belong properly.

The reason for this is two-fold: The railroad management is brought in contact with every phase of city life; every character of request for assistance is made upon it, from a contribution to a church bazaar, to a contribution to an international exposition; from furnishing a special car for an infant's baptism, to a funeral car for a man's last ride; from the just demand for increased service during the busy hours of the day, to the unjust demand of the real estate speculators that unprofitable roads should be built into unpeopled suburbs. No other business comes in contact daily with so many people, so touches the daily life of the citizen, or is so important to the orderly conduct of the people's business.

The railroad has no control over the street traffic. Oftentimes its tracks are the only well-paved part of the street; wagons and teams crowd upon them, and an inefficient or inimical city administration, neglectful of the people's comfort, allows the ordinary street traffic to delay the cars. The hurried and impatient patron, who does not see the cause, blames the railroad for the delay. While a large majority of the people are reasonable, the railroad must haul all kinds, the halt, the lame, the old, the blind, the thoughtless, the careless and the impatient. The inconvenience necessarily incident to the surface transportation of all large cities breeds discontent and creates a fertile field for the agitator.

And this brings us to the second cause for the attacks upon street railroads. There is a growing class of men in all of our cities, socialistic in their views, some sincere, others insincere, who desire to create that condition of unrest and distrust which will prevent further street railroad extension and bring about municipal ownership. With this class the end justifies the means. No attack is too wicked, no misrepresentation too false, provided it aids in the creation of public sentiment in favor of municipal ownership.

Allied with these men are local agitators and ward politicians who hope through municipal ownership to acquire jobs for themselves, or increased power through the increased patronage which would some from public operation.

Allied with both of these are the unscrupulous demagogues who seek support, frequently as reformers, sometimes as progressive reformers, through fostering unrest and discontent, and who believe that so great is the unrest and discontent of the country that popularity and power are to be gained through attacks upon corporations. Occasionally this demagogue is a practical politician who declares that the interests must be driven out of politics, while he seeks to extort excessive fees or campaign contributions from the railroads on the ground that he alone is strong enough to protect the corporation from the attacks of its enemies. The logic of his position is this: The corporate manager cannot and should not take an active part in local affairs. To do so will render the road unpopular. The managers therefore should stand aside and rely upon others to protect their interests. Publicly this politician will declare that he seeks to drive the corporations out of politics; secretly he will say to the corporate managers that he proposes to protect their interests and they can rely upon him. Under this system the corporation finds itself with no means of protection except the good will of the political boss. It has been and will continue to be open to cinch-bill annoyances and blackmail of every character. There is but one safe rule. A politician who will not enter by the front door should be barred from the back door.

There is not an intelligent street railway manager

[1] Abstract of paper presented at meeting of the American Street & Interurban Railway Association, Atlantic City, Oct. 10-14, 1910.

in the country who does not desire to keep his corporation per se out of politics. No class of men is more opposed to corrupt alliances between the corporations and politicians; no men more earnestly favor the overthrow of the boss system in party management; no men more sincerely desire non-partisan discussion and non-partisan action in regard to the serious business problems involved in city transportation; no men are better equipped to help the people arrive at correct conclusions on this subject; no men have greater selfish interests or broader patriotic motives in seeking the proper solutions of the problems; no men will unite more cordially with their fellow citizens in an effort to better conditions, materially and morally. They believe earnestly that the railroad companies and the problems involved in their operation should not be made the targets of political attacks, but should be left unmolested, subject to public, non-partisan control, to carry on their business.

They know that co-operation between the railroad, the general public and city officers—cordial, sympathetic, will co-operation—is an essential to efficient service. In some of our larger cities intelligent police regulation of the general traffic of the street has become most effective in preventing blockades and in keeping the street car tracks free for public use. It is only through such regulation, which the railroad itself cannot enforce, that delays can be prevented.

There are two methods by which corporate interests can be protected. One is by their officers and officials apparently abstaining from politics, apparently devoting themselves entirely to business, claiming to be business men and not politicians, and making secret deals with those politicians who will give them protection. This has been in some degree the method of the past, and this has been unquestionably a cause of political corruption. The corporation, without a just public opinion upon which to rely, has found itself without any defender except the corrupt politician, whether under the name of reform or machine, who has demanded his price for his protection.

The other method is for the corporate manager to defy boldly the politician, high or low, who undertakes to drive him from a participation in public affairs; to refuse to be blackmailed, to refuse to buy political protection through campaign contributions, to put his trust in the plain people of the country, and, willingly, boldly and fearlessly lay his case or his needs before them.

I advocate, absolutely, clean political methods—bold, fearless, courageous methods—and the establishment in every community, by the men who manage corporations, of a reputation for fearless political courage, until they secure a leadership in civic affairs recognized to be disinterested and for the public good.

I advocate a campaign of education, the widest publicity of the affairs of public service corporations, freedom from entangling political alliances, the sternest integrity in the administration of both the private and the public side of corporate management, and the passage of such laws as are necessary to establish non-partisan tribunals of a judicial rather than a political character, with power to grant franchises and regulate public service corporations.

One of the causes of political distrust of the corporation today is that corporate managers have sometimes professed to be out of politics, while they have had secret deals with the demagogue who has been proclaiming his desire to keep the railroads out of politics.

I have in mind the picture of a scene that occurred in the office of the Governor of one of our States. He was in discussion, friendly and cordial, with the geneeral counsel of a railroad. While this discussion was going on some of his farmer constituents appeared at the door of the executive office. The back of the railroad counsel was to the door; the Governor faced it. He saw his constituents, immediately raised his voice, and said, without pertinency to what was then transpiring, "I tell you, sir, I will not allow myself to be dictated to and controlled by the hireling of any corporation," and launched into a tirade against railroads. His constituents paid their visit and left, when the Governor apologized for the abrupt change in his manner by the statement that it would never do for him to be found in friendly conversation by his country constituents with a corporation lawyer.

These facts are calculated to make cynics of railroad managers, and distrustful and suspicious voters. I am an opponent of corruption, a contemner of hypocrisy, and an advocate of widest publicity. Why should we leave the field of publicity to the muckraker and the demagogue? The people in the end are the arbiters of our destinies; the great bulk of them are honest, upright, sincere, truthful; they hate a liar, and if the demagogue lies and gets off with his lies, it is because he is not exposed and the people are not convinced of his malevolence and untruthfulness—they too frequently attribute his misstatements to mere impulsiveness. But the railroad man, whose corporation will continue to operate after his day is past, cannot afford to lie; he must be truthful, plain spoken and upright. He has not only his own moral character and personal future to regard, but also the trusts which are imposed upon him, in behalf both of the stockholders and of the public whose servant he is.

There is no doubt that a campaign of lies has been inaugurated and is being carried on by our opponents. Why should not the railroad interests of the country inaugurate a campaign of truth and go before the people confident that the campaign of truth will win out over the campaign of lies? They may meet with temporary defeat here and there. What of it? Defeat should only be an inspiration for more vigorous action if a man is armed with conscious integrity. The time is ripe for a movement of this character.

We represent one of the most honorable of occupations, one that requires a high order of executive ability and a high order of technical information. The men who manage the railroads are patriotic, upright and honest. They have the capacity to express themselves, and the means at hand of laying their views before their fellow citizens.

We know that no men are so interested in the material welfare and growth of a city as those who own its street railways. We must make the public know this too. The rate of fare is fixed; it cannot be increased, and there is no possible way by which gross earnings can be increased except through increased population. The public must be educated to recognize

that there is no conflict between it and its railroad managers. No men are willing to work harder, more patiently, more effectively for the public welfare. No men are more interested in good government—not the bastard sort of the reformer for office, but careful, prudent, economic, efficient, honest government.

Now, you cannot eliminate the corporations, and the men connected with corporations, from an interest in public affairs. They pay taxes; they meet the public in every direction; they want careful, prudent, economical government; they form a part of the best life of the country. It is foolish to assume that under modern conditions corporations can be destroyed, or that it would be wise to destroy them if they could be destroyed.

A bold, frank, open courageous course will give any man a standing, whether he is a corporate manager or whether he is not, in any American community. The people will listen to what he has to say, if they believe truth and honesty are in his words, backed by strength and character.

Railroad managers should take an active leadership in providing the best method by which franchises may be granted with the least temptation to corruption and the best results to our cities. This is a subject upon which all good citizens should unite. Corporate managers do not desire to overreach the people in acquiring new franchises.

No greater misconception exists in the public mind than that the franchises generally of street railways have been founded in corruption. As a matter of fact these franchises were originally granted to the foremost men in their respective communities, often influenced by a noble public spirit and the desire to give to their communities the transportation absolutely essention to a city's growth. They were granted when the risk in street railway construction was great and when the communities were more anxious to grant the franchises. In many cases, too, they became burdens instead of benefits to the promoters and yielded no profits for many years. Such corruption as has existed has grown mainly out of efforts to procure speculative franchises in opposition to the old established roads, most frequently not to give any needed transportation, but for the purpose of levying blackmail upon the older enterprises through forcing them to purchase the new grants.

We may admit, however, at the start in the discussion of this subject, that the present method, by which the State grants a charter to a public-service corporation, and then leaves it to the local legislative bodies in our towns and cities to grant franchises for the use of the streets and to regulate the rates of public service corporations, has been the source of corruption. The system is wrong. So long as greed is strong in the human breast, so long will you find some politicians ready to hold up the corporations until they have exacted their pound of flesh. Nor will the fact that the public laws controlling the city charter provide for the freest advertisement of franchises for sale to the highest bidder meet the difficulty. A striking illustration of this fact has been found in San Francisco. By the charter of that city today any franchise for a street railroad must be advertised for 90 days and the bidder must pay a minimum amount of the gross receipts to the city government. At the end of 25 years all the property of the railroad passes to the city without consideration other than the grant of the original franchise.

Some of the foremost gentlemen of San Francisco applied to the Board of Supervisors for a franchise to build a railroad through the sand dunes of what is known as the Sunset District. There were no houses in this district and the streets had not been opened. These gentlemen, who were large real estate owners, determined to open an important boulevard at their own expense, and to build a street railroads into this desert of sand for the purpose of developing their property and putting it upon the market. The street railroad franchise was of no value. They knew that it could not be made profitable, and that they would be compelled to charge the money which they expended in the construction of the boulevard and the building of streets to the cost of their real estate. It was manifest that it was to the interest of the city that the franchise should be granted, and yet it was held up for months by the Board of Supervisors. Finally some of the men connected with the enterprise employed a prominent lawyer, who then also occupied the position of a political boss. They paid him a fee. Still the franchise was not passed during his period of political control. Subsequently certain members of the Board of Supervisors were bribed, on a skating rink ordinance, by a set of buccaneer financiers and politicians who had banded together to gain control of the city for personal exploitation. These men offered and gave complete immunity to the Supervisors whom they had bribed provided the Supervisors would incriminate, among others, these land owners in the Sunset District. The Supervisors promptly accepted the price of their immunity, and declared that they had been promised money by the so-called political boss if they would pass the ordinance for the railroad. The land owners who had projected the road and who were ready to build, and did subsequently build, a splendid boulevard at their own expense were promptly indicted. The political bass was also given a written contract of immunity in the hope that he could be forced to incriminate the land owners among others, but it developed that the Supervisors never received a cent of money either from the political boss or from the gentlemen connected with the enterprise. The political boss declared that he had received a fee in connection with the road, but that he had never been authorized, directly or indirectly, to pay or promise any money to the Board of Supervisors, and had never done so, and that he would not perjure himself to convict innocent men. The franchise was held up for nearly three years, when the socalled reform administration granted it under the public pressure which had been aroused and the fear of political retribution if they held it up longer. The result was that a most unprofitable street railroad was built, while the assessor states that real estate values tributary thereto advanced 800 per cent.

Now, no system of granting franchises under which such a condition has occurred, and may recur in the future, is wise or safe. I suggest that the remedy is for the State to refuse to delegate the power of granting franchises and regulating their rates to varied local bodies, too frequently corrupt and irresponsible,

but to reserve this great right to itself; to provide franchise counts or public service commissions composed of a few men of the highest ability, character and integrity, who should have the power to grant franchises only after the fullest public hearing. The court or public service commission should hold public meetings in the different cities and towns. The grant of franchises should be withdrawn entirely from politics and left to such court or commission.

The period when public pressure and the consideration of the public phase of railroading is brought close home to a street railroad manager is during a strike. Then it is necessary more than at any other time for a railroad manager to have a definite conception of his public duties and of his private rights. Tremendous pressure will be brought to bear upon him by civic and religious bodies, well-meaning to the core, but who, without knowledge of the great fundamental rights which lie at the basis of society, are willing to temporize and adopt any expedient which will produce a speedy resumption of traffic.

No man, no set of men, has a right to say to any man he shall not work when and how and as he pleases; no employes of a corporation have a right to abandon their occupation and still claim to have relations with the corporation. I concede to the employes the right to organize for mutual protection, to better their condition, and to stop work when they want to, even without notice to their employer, but I deny absolutely the right of any body of men to leave the service of any employer and say to him, "We will prevent by violence other men from seeking your employment and you cannot carry on your business without submitting to our dictation." No strike can be successful unless the employer is weak enough to deal with the men after they have struck, and industrial strife will necessarily stop if strikes continually fail.

Our government was formed upon the principle that there were certain inalienable rights of man of which the whole of society could not deprive him, and that one of these inalienable rights was free speech, particularly in defense of himself and his property when attacked. The railroad manager himself should seek to deprive no man of his liberty, but he should allow no group of men to deprive the humblest of his employees of the liberty to work if he wants to work and if he is faithful and honest in the discharge of his duties. He must be prepared to defend vigorously the rights of the property entrusted to his care, and that of his humblest employee in his own labor.

No man has so great an interest in the stability of property rights as the honest workman, of whatever calling, who has no property except the property to be acquired through his own labor. No prosperity can exist except where there is the utmost protection and safeguard to the rights of the individual in his property, whether it be in his labor today, or whether it be in the results of yesterday's labor which he has husbanded and saved. All despotic governments which have failed to give full protection to the rights of property have had in them men of large wealth, who, in one way or another, through power or corruption, were able to take care of themselves, but the masses of mankind under such despotic governments have been invariably reduced to the lowest conditions of poverty. You cannot separate the rights of man from the rights of property acquired by his labor without depriving him of his liberty and reducing him to a condition of serfdom. Railroad franchises rest upon the law to the same degree that the title to the real estate fronting upon the streets rests upon the law. Both rights were acquired by grants from government, but the rights entrusted to our care are clothed with a public use, while the rights deprived from a grant to a piece of real estate may be all private. It behooves, us, therefore, more than any other class of men in the country, to study and to understand what are our private rights and what are our public duties.

It is the patriotic duty of the railroad manager, fighting demagogism and socialism on the outposts of society, to stand firmly for the protection of those limitations which form the basis of the liberty of the individual. He must learn and he must teach that our principles of government did not spring from a written constitution, but that our written constitution, carrying with it the protection of life, liberty and property, sprang from principles which were the product of eighteen centuries of conflict with despotic power; that the principles that a contract must be held inviolable, and that the humblest citizen of a community, as well as the richest, has certain inalienable rights of which the whole society cannot deprive him, are necessary in order that the people may prosper and find liberty and happiness in their prosperity; that a government of, for and by the people has no place in it for the political serf or the beneficent ruler; that equal and exact justice to all men can be found only under a reign of law. In this day, when we hear so much of the conservation of our material resources—and every patriotic man wants to see them intelligently conserved and legally developed—I say to you, gentlemen, that the conservation of the country most needs is the conservation of a government of law.

CHINESE COAL FOR UNITED STATES.

On August 10, 1910, a Chinese mining company made a shipment of sample coal, coke and cement to San Francisco, the total value of the shipment amounting to $34,863, the cargo being made up as follows: anthracite, 2000 tons; lump, 920 tons; slack, 1980 tons; special coke, 5 tons; cement, 10 casks. This fact is more significant when it is considered in the light of the recent departure for the United States of a representative of the company, under instructions to inspect the larger towns and cities of the Pacific Coast with a view of discovering a market therein for the products of his company. It means that a definite and energetic attempt is being made by the company to find an opening outside of China for its excess output, and if the attempt is successful, American coal will find a dangerous rival on the Pacific Slope. This company is one of the strongest and best-managed industrial concerns in China, if not the strongest. It has behind it substantial Belgian and British capitalists, and its direction is by an able foreign engineer. Up to the present it may be said to have been in a stage of preparation. It is now in a position to hold its own in the China coal market and to look abroad for other markets to supply.

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POWER AND GAS

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Induction Generators

The induction generator is an inverted induction motor of the squirrel cage type driven above synchronism. Though it has long lain dormant as a sort of scientific curiosity, an interesting example proving the general rule of the reversibility of dynamo-electric machinery, it has recently been resurrected to remedy some of the difficulties created by the tandem operation of synchronous generators on an alternating current system.

A crude conception of the conditions existing in such a system may be gained by comparing it with one of the 20-mule borax teams which an enterprising manufacturer has made familiar to us all. Let us assume that the mules are the generators and the wagons the load, which varies with the grade; let the speed of the team correspond to the voltage of the system and its pulling ability to the current; let the leading wattless current be represented by the activity of the leaders and the lagging wattless component by the inertness of the wheelers.

The freighter with his jerk line controls his leaders just as a governor adjusts the synchronous generator to load variations. These leaders are the most active animals in the team and stir up their more sluggish followers, especially the wheelers. Incidentally they would be just as well adapted to haul a light buggy as to be driven in tandem with a heavy team. Yet if they come to a sudden steep hill they are not good pullers but commence see-sawing back and forth and may lose the load entirely, while on the down grade they are likely to run away and wreck the outfit. They require some steadying and soothing influence, something that will pull harder on the up-grade and hold back on the down. This is provided by the wheelers who work well in tandem but are too slow and lazy to be driven alone, being mere machines giving power to the team but having nothing to do with its rate of travel.

By substituting synchronous generators for the leaders and induction generators for the wheelers we can get a mental picture of the functions of these two types of machines. The induction generator gives current only when connected to a system containing synchronous machines and it has no independent voltage. It merely feeds power into the system and does not participate in the voltage regulation. The synchronous generator gives almost unlimited current on a short circuit, corresponding to the leaders on a down grade, but the induction generator ceases to generate when short circuited. Synchronous generators supply both wattless and power current, while the induction machine supplies only power current.

Contrary to Mr. A. L. Allen's statement at the conclusion of his excellent paper, published elsewhere on this subject, the induction generator is fast becoming of industrial importance, the most notable installation being three 7500 kw. units already installed in the power plant of the Interborough Rapid Transit Company of New York City, to which other units of the same type are now being added. Without doubt it will be but a short time before similar machines are tried out on some of the Pacific Coast high tension systems.

PERSONALS.

W. G. Vincent Jr. is at Los Angeles.

W. S. Tevis of Bakersfield is at San Francisco.

Frank H. Short of Fresno, was at San Francisco last week.

C. L. Cory is at Modesto in connection with the rate for lighting question.

G. J. Kuhrts, an electrical engineer of Los Angeles, was at San Francisco last week.

T. A. Work, the electric supply dealer of Monterey, was at San Francisco last week.

William Stanahan with the Coalingua light and power plant visited San Francisco this week.

E. V. D. Johnson, manager of the Northern California Power Company, is making an Eastern trip.

R. S. Buck, of the engineering staff of Sanderson & Porter has returned to San Francisco from the East.

George E. Church, who has electric power interests at Fresno, was a San Francisco visitor last week.

F. G. Baum, of F. G. Baum & Co., has returned to his San Francisco office after a trip to Santa Barbara.

Paul Shoup, assistant general manager of the Southern Pacific Company, in charge of electric lines, is at Los Angeles.

Cyrus Pierce of N. W. Halsey & Co., who are heavily interested in Pacific Coast electrical securities, is in New York City.

Thos. Morrin, consulting mechanical engineer, has returned to his San Francisco offices after a three months' vacation.

H. H. Hornby, manager of the conduit department of the Sprague Electric Company, is at the San Francisco branch office.

S. J. Lisberger has been elected chairman of the San Francisco Section of the American Institute of Electrical Engineers.

R. T. Brock of New York City is at San Francisco in the course of a Pacific Coast trip being largely devoted to power plant inspection.

Sidney Sprout returned to San Francisco last week after a trip to Oxnard in connection with some important engineering work in Ventura county.

W. F. Smith, general construction foreman of the electrical department of the Pacific Electric Railway of Los Angeles, motored to San Francisco during the past week.

Leon M. Hall, of Hall, Demarest & Co., returned last week from Red Bluff. He is doing the electrical engineering work for a new development in that section of the country.

J. C. Murray, sales engineer of the Kellogg Switchboard & Supply Company, has returned from a South American trip and will immediately take up his work in the telephone field.

B. C. Holst, who resigned last year as manager of the telephone sales department of the Western Electric Company at San Francisco to take up similar work with the Northern Electric & Manufacturing Company of Montreal and Winnipeg, is renewing old friends during a brief visit to the Pacific Coast.

George E. Pancoast, chief engineer of the Hearst News Service, recently arrived at San Francisco and has already closed contracts for several thousand dollars' worth of machinery, including a number of General Electric a.c. motors for installation in the new 12-story building that is to be occupied soon by the "Examiner" plant.

Calvin W. Rice of New York, secretary of the American Society of Mechanical Engineers, who has been touring the Coast, left Palo Alto for Los Angeles this week on his way East.

W. A. Hillebrand has been elected chairman of the papers committee of the San Francisco Section of the American Institute of Electrical Engineers, the other members being G. Deakin and A. H. Halloran.

J. G. De Remer has resigned his position with the Westinghouse Electric & Manufacturing Company at San Francisco to become assistant general manager of the United Light & Power Company with offices in the Mechanics' Institute Building, San Francisco.

A. Boissonnas, who is at the head of a number of electric power enterprises in Switzerland, has arrived at San Francisco from Geneva. He is making an inspection tour of the principal hydroelectric plants of this country, accompanied by E. B. Tracy, of W. P. Bonbright & Co., New York, bankers, interested in western electric power securities.

PACIFIC COAST JOBBERS' MEETING.

An enjoyable outing was held by the Pacific Coast Jobbers' Association at Catalina Island last week. Judging from the reports from those participating, the varied means of entertainment presented by this favored spot were much enjoyed.

Naturally the chief interest centered in the fishing for which this island is famed, prizes being offered for the largest fish caught with both light and heavy tackle. Mr. Albert H. Elliott caught a 62-pound shark with light tackle, thus earning a handsome humidor and Mrs. Thos. M. Debevoise was presented with a desk clock as a reward for her prowess in catching a 30-pound albicore with heavy tackle.

The golf honors were captured by Mr. F. B. Gleason, manager of the Western Electric Co., who won both the E. K. Patton and the regular Jobbers' cup. The meeting was concluded with a sumptuous golf dinner at the Hotel Metropole. Members and guests present included:

Mr. and Mrs. Thomas M. Debevoise, Mr. and Mrs. H. G. Aylsworth, Mr. and Mrs. George Cole, C. L. Gilson, R. D. Holabird, Thos. E. Burger, F. H. Poss, Joseph A. Herr, A. H. Elliot, F. B. Gleason, Franklin Overbagh, T. E. Bibbins, A. Carrigan, H. V. Carter, C. H. Carter, S. B. Gregory, C. R. Dederick, Ross Hartley, Frank Fowden, J. Schaufelberger, N. W. Graham, W. L. Goodwin, C. C. Hillis.

PACIFIC COAST MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

A meeting was held at the Palace Hotel October 14th, which was attended by Calvin W. Rice, secretary of the American Society of Mechanical Engineers, and a number of local engineers. The subject of organizing so as to hold meetings of the society at San Francisco was discussed after A. M. Hunt had been elected chairman. A resolution was adopted inviting the American Society of Mechanical Engineers to hold its semi-annual meeting at San Francisco at the time of the Panama-Pacific International Exposition in 1915. A. M. Hunt, W. F. Durand, E. C. Jones and Thomas Morrin will constitute the executive committee.

ILLUMINATING ENGINEERING COURSE AT JOHNS HOPKINS UNIVERSITY.

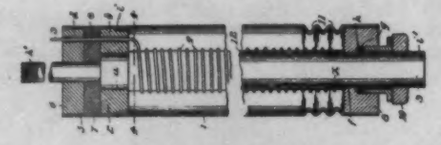
The course of Lectures on Illuminating Engineering, which is to be held at Johns Hopkins University October 26th to November 8th, under the joint auspices of the University and the Illuminating Engineering Society, is receiving a large amount of attention from the many electrical interests throughout the country. Many of the technical universities maintaining courses in electrical engineering are planning to send representatives to attend the course of lectures, in order to found complete undergraduate courses in those institutions.

PATENTS

972,209. Swiveling Attachment Device for Electrical Apparatus. John H. Morley, Johnstown, Pa. An attachment device comprising a body portion carrying one set of wires, a plug carrying another set of wires, said plug being inserted

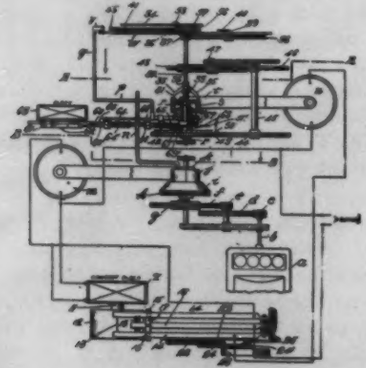
within the body portion and connected thereto by means of a spring on said plug, a sleeve insulated from said spring and loosely surrounding the sides of the plug to permit rotation, said sleeve being in contact with the body portion, and a spring connecting the sleeve to one of the terminals.

972,308. Electric Heater for Oil-Wells. James E. Williamson, Pittsburg, Pa. In an electric heater for oil wells, the combination with the pumping tube, of a heater comprising an outer and an inner shell, and an electric resistance arranged upon the exterior of the inner shell, the said shell



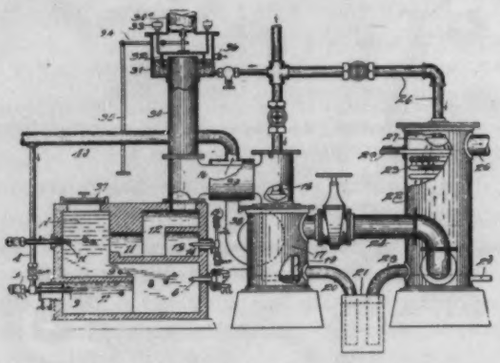
constituting the return conductor of said resistance, the said resistance being located in a water sealed chamber between said shells, the inner shell being adapted to be connected to said pumping tube, and the outer shell having a series of corrugations in the wall thereof.

972,538. Maximum-Demand Meter. Vladimir Karapetoff, Ithaca, N. Y. In a meter of the class described, the combination with a wattmeter and means for indicating the maximum power demand during a given interval of time, of a two-part clutch which operatively connects said wattmeter



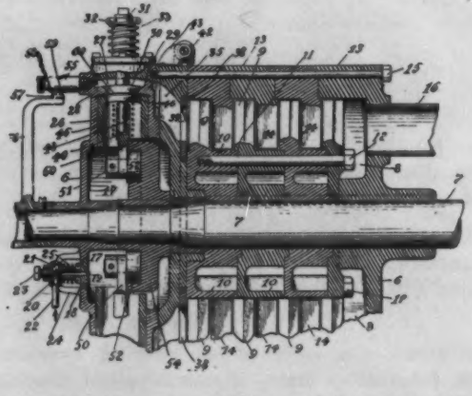
and means; an armature formed with ears and attached to one of the parts of said clutch; and electromagnetic devices for raising and turning said armature to release said clutch and restore said means to their initial position, said ears insuring that the final position of said means will be accurately at their zero.

972,486. Continuous-Make Gas Apparatus. Elmer E. Wickersham, Watsonville, Cal. The combination in a gas apparatus, of a mixing chamber, a combustion chamber below the mixing chamber having an arch separating it from said mixing chamber, a burner in the combustion chamber, a chamber in the rear of the combustion chamber and connecting



with a space above said arch, the combustion and mixing chambers opening into the rear chamber, and an atomizer with an oil and air supply connection, said atomizer discharging in the rear chamber and approximately in line with the mixing chamber and above the combustion chamber burner.

972,642. Gas-Turbine Engine. William A. Reed, Hollywood, Cal. In a gas turbine a plurality of radially arranged compression chambers, each chamber having a piston therein; a driving shaft; means secured to said shaft to operate said piston; valves in the ends of said pistons; a feeding chamber in communication with said compression chambers; radially arranged explosion chambers in com-



munication with the outer ends of said compression chambers; valves in said last communication; a vane chamber having an exhaust port; direction changing chambers having ports opening into the vane chamber; means to control said last mentioned ports; rotary vanes within the vane chamber secured to and projecting radially from the driving shaft, and radially arranged deflecting vanes secured to the vane chamber casing, and projecting toward the shaft, said deflecting vanes alternating with the rotating vanes.

BOOK REVIEWS

Solenoids, Electro Magnets and Electro Magnetic Windings. By Charles R. Underhill, 342 pages, 5x7½; 223 illustrations. D. Van Nostrand Co., New York and Technical Book Shop, San Francisco. Price, $2.00.

This treatise brings into compact form a wealth of valuable information on electro magnets, which govern almost all electrical apparatus. The introductory chapters are devoted to definitions, units and calculations of simple electric and magnetic circuits. The following chapters define the solenoid and give theoretical and practical characteristics of air-return and iron-clad types both with and without armatures. Subsequent chapters are devoted to alternating current electro magnets. The concluding chapters deal with practical designing and construction, including insulation, winding and heating for regular and special types. The last chapter is a compilation of tables and charts for convenient reference. The book is well written and contains much valuable data.

Standard Handbook for Electrical Engineers. 1500 pages; 4x7, leather bound. McGraw-Hill Book Co., New York and Technical Book Shop, San Francisco. Price, $4.00.

This is the third edition and 19th thousand of this book which has become a standard in fact as well as in name within less than three years. Its contents are so well known as to require no exhaustive summary at this time. It is divided into twenty sections, each section written by an expert and thumb indexed for convenient reference. Many of these sections have been entirely rewritten in accordance with the dictates of recent practice, all of them have been corrected and most of them have been enlarged. This edition has 200 pages more than its predecessors. It is invaluable to every electrical engineer.

Power Gas and the Gas Producer. By J. C. Miller; illustrated; 184 pages, 5x8. Popular Mechanics Co., Chicago; Technical Book Shop, San Francisco. Price, $1.00.

This text is an endeavor to give a popular explanation of the theory and practice of producer gas, written for the layman. This necessitates the elimination of all chemical and mathematical formulae and the substitution of generalities for specific data. It is divided into eleven chapters and is first concerned with the properties of various kinds of producer gas including their composition, heat values and their physical characteristics. Brief descriptions of several styles of producers are illustrated by both text and pictures and a critical discussion given of the fuels best adapted for use in producers. One chapter is devoted to the practical operation of the gas producer and concluding sections contain detailed comparison of gas power and steam, including their reliability, convenience and cost. A matter of practical interest to Pacific Coast readers namely oil gas producer gas receives no mention whatever. While the book is of little value to the engineer it gives an excellent introduction for more advanced study on the part of the beginner.

Electric Motors. By Francis B. Crocker and Morton Arendt; 291 pages, 6x9; 158 illustrations. D. Van Nostrand, New York City, and Technical Book Shop, San Francisco. Price, $2.50.

This is essentially a college text book, being an outgrowth of a course of lectures on electric motors and their application given at Columbia University. The subject is so clearly and logically presented and with such accurate detail that it will likewise prove of value to anyone operating electric motors. After a brief historical introduction, the authors give a general discussion of the different types of direct current motors and summarize the advantages of electric drive. This is followed by chapters devoted respectively to direct current shunt, series and compound motors, the theory of the machine being developed co-ordinately with the practice. In each case there is given test data and full analysis of the effect of varying cnnditions, together with exhaustive treatment upon the different methods of speed control. Following this is a brief classification and history of alternating current motors which are subsequently treated in more detail under the headings of synchronous motors, induction motors and commutating alternating current motors. While in no sense a popular treatise, techincal problems are so carefully explained as to be capable of solution after a little study.

The History of the Telephone. By Herbert N. Casson; 315 pages, 5x8, well illustrated. A. C. McClurg & Co., Chicago; Technical Book Shop, San Francisco. Price,

An occasional dip from the stern realities of engineering into the romance of its development is refreshing and inspiring. In a happy intermingling of history and biography, Mr. Casson tells the story of the telephone. It is as interesting as a novel and has the added charm of facts. In his skillful handling of words, however, it must not be forgotten that the author tells but half the story, for this book would better be entitled "The History of the Bell Telephone." So while this narrative is read and enjoyed it should be with the knowledge that there are other chapters equally interesting which have been omitted. The history of the Civil War writter with the bias of a Northerner may give just offense to a Southerner. In fullness of time therefore we look for a like history of the Independent telephone which will also reflect due credit as does this book to those who have developed the wonderful Bell system.

WASHINGTON WATER POWER DEVELOPMENT.

SPOKANE, WASH.—The Washington Water Power Company, controlled largely by New York and Boston capital, has acquired 7000 acres of lands, including power sites on both sides of the Spokane river in Spokane and Stevens counties, north of Spokane, for $700,000 and it is given out by D. L. Huntington, president of the corporation, that other acreage will be bought, preparatory to expending $1,000,000 in power development work. The company now has sufficient holdings to back water over a strip of 20 miles in length, thus providing one of the largest reservoirs on the Spokane river. The deal for the Big Bend Water Power Company's lands and rights, involving about 400 acres, was consummated last week at a figure said to be $250,000. The officers of the Big Bend Water Power Company are: President, B. F. O'Neill, Wallace, Idaho; vice-president and general manager, E P. Spalding; secretary and treasurer, Mrs. A. M. P. Spalding. It is on this site that a gigantic dam will be built for backing the water over the large area. From the Spalding site alone it is estimated that between 75,000 and 80,000 horsepower can be developed. It will call for a dam 150 feet in height, connecting perpendicular granite walls 300 feet from base to cap. The company already has started several crews of men at work. The site bought from H. L. Moody of Spokane and his associates is four miles above the Lapray bridge, one of the landmarks of the Northwest. This site is purchased for the riparian rights solely. The bridge will be inundated in the present plan of development about 40 feet. This will necessitate the moving of the crossing to another point. The large increase in the company's bond issue, from $10,000,000 to $15,000,000, last year, figures in the new project, and it was this which brought several of the large stockholders from the east to Spokane a few months ago. The company started work in September on a tunnel in the Spokane river near its plant in Spokane, but abandoned this work recently.

MARTINEZ, CAL.—Work on the grading of the right of way for the Oakland and Antioch Railway, between Bay Point and Lafayette, has been resumed by the Bay Point Construction Company in order to finish the work left incomplete by Hard & Co., which was temporarily engaged to do part of the work. Seventy-five men will be set to work to complete the line before the winter season.

INDUSTRIAL

AN INNOVATION IN SMALL SWITCHBOARD CONSTRUCTION.

A novel type of small switchboard capable of being not only easily increased in capacity but at the same time readily convertible to suit various service conditions is being marketed by the Western Electric Company. The telephone company that operates a small exchange is confronted with the problem of selecting a switchboard of the proper style and capacity that will meet their service conditions at the present time as well as in the future. This problem has been all the more perplexing when the telephone company is unable to determine with any degree of accuracy what their future requirements might be. Thus they have often found it necessary to either purchase a switchboard that might serve for only a short time and then discard it or they might find at a later date that they had purchased a switchboard of such a large size that they would never be able to make full use of it.

1800 Desk Type equipped with Suspended Transmitter and Head Receiver and 20 lines. Uses Combined Jack and Signal.

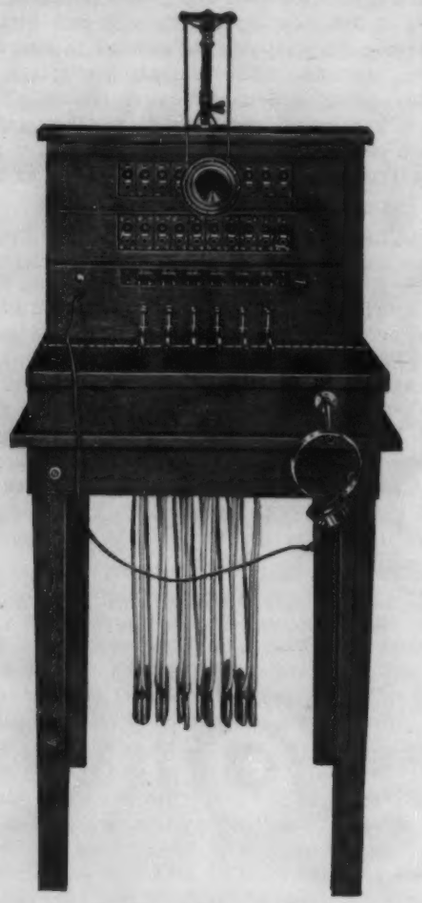
This and other problems have been very cleverly solved by the Western Electric Company with the design of their new No. 1800 unit type switchboard. It will be noted from the illustrations that this switchboard is built up of several separate parts, comprising top units, line units, cord units and supporting units.

As the telephone company's requirements increase so can the switchboard capacity be increased and at all times the telephone company has a minimum investment.

The top units can be supplied with either a hand telephone set or a suspended transmitter.

The line units can be supplied with either self-restored jacks and signals, manually restored drops and jacks, ringers, through toll line apparatus, etc.

The cord units can be supplied with either listening jacks and supervisory drops or ringing and listening keys and supervisory drops. They can further be furnished with the single supervision, single supervision, non-hang-up or single supervision, non-ring-through, non-hang-up. The supporting units



1800 Floor Type equipped with Suspended Transmitter and Head Receiver and 20 lines. Uses Combined Jack and Signal.

can be supplied for wall type of switchboard, for floor type or for desk type.

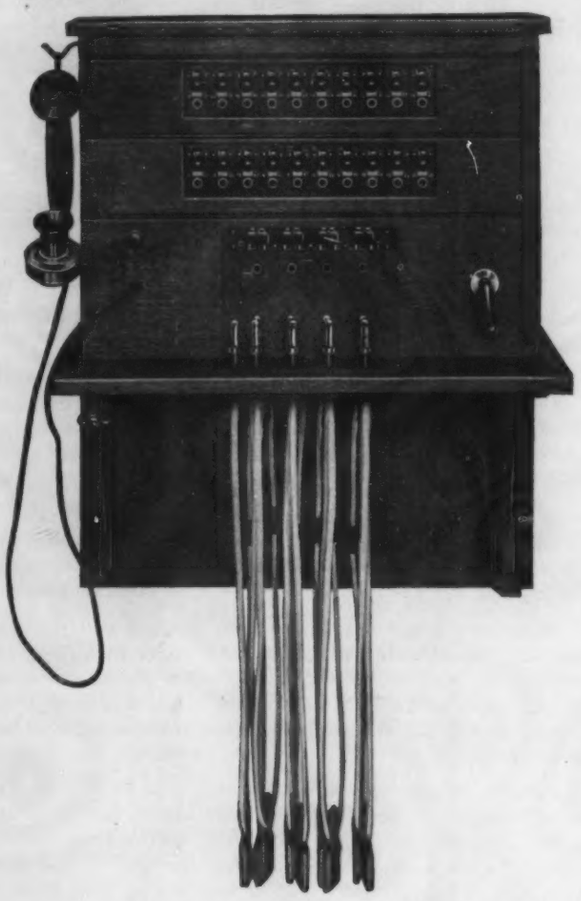
Many small switchboards are situated in business places or private homes, where the operator has other duties to perform. Under such conditions a wall type, equipped with a hand telephone set is found the most desirable.

As the telephone company's business increases the operator may be required to be seated at the switchboard the greater part of the time and, therefore, a floor or desk type of switchboard having a suspended transmitter is quite essential. With the sectional unit scheme, a switchboard cannot only be increased in capacity but it also can readily be converted to any desired type.

There are many hundreds of switchboards that are capable of giving several years of good service that are stored away because the telephone companies have no further use for them since they no longer fit in with the new order of things. Such switchboards are unquestionably a bad investment because the telephone company did not realize the full value from them. On the other hand, this new unit type of switchboard would be a good investment, since on account

of its elasticity a place of service could always be found either in the whole of in part.

All of these units are especially designed so that they can be assembled and installed with unskilled help. Screw-type of terminals are provided for all of the line wire connections. All electrical connections between units are automatically made by means of the machine screws that hold the various units together, thus it is impossible to connect them up wrongly. This series includes 30 different units, which enables the telephone company to meet every legitimate condition.



1800 Wall Type Equipped with Hand Set and 20 lines and using Combined Jack and Signal.

ELECTROLYTIC LIGHTNING ARRESTERS.

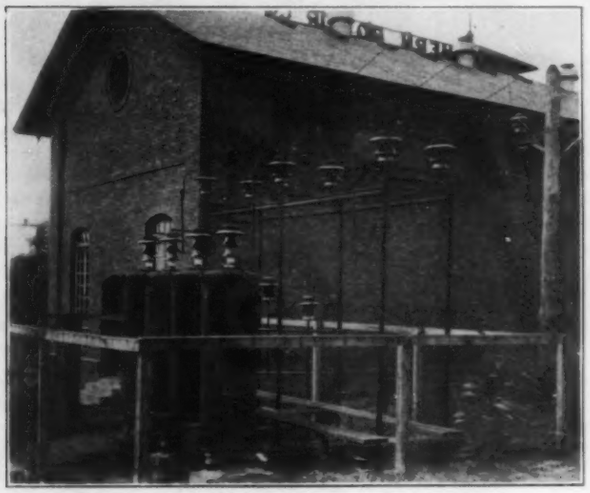
Many devices have been placed upon the market for the protection of electric equipment from abnormal voltage on the line, due to lightning or any other cause, one of the most effective pieces of apparatus devised for this purpose being that type of lightning arrester which depends upon the safty-valve action of a film on an aluminum plate. This type is commonly known as the electrolytic arrester and, in practice, consists of nested aluminum trays filled with electrolyte and submerged in oil.

The electrolytic lightning arrester has ideal characteristics and closely resembles in action a relief or safety valve, which it truly is for the electric system. The horn gaps which are between the arresters and the line break down on over voltage, and if this voltage amounts to over approximately 330 volts per tray, a free passage through the film from tray to tray and thence to the ground is provided. When the voltage drops to normal, which is below the critical voltage of the tray, the apparent resistance of the film reasserts itself and the flow of the current is cut down so that the horn gaps disrupt the arc and all further flow of current ceases.

The nested trays are placed in oil-filled, welded steel tanks, which for 22,000 volts and above are built with cast covers and outdoor terminals, so that the entire arrester can be placed outdoors. The complete arrester consists of four tanks mounted on an insulated platform for ungrounded neutral service, and three tanks grounded for grounded neutral service. For 13,200 volts and under, the arrester is arranged for indoor service only, as the horn gap setting is so small that much more effective service is obtained when the arrester is housed. For the lower voltages the general arrangement of tray is the same, but a smaller number of tanks is used.

Since, when the electrolytic type of arrester is allowed to stand without current passing through it, the film on the plates dissolves, it is necessary to periodically pass current through the arrester in order to keep the film in the best condition. This prevents an abnormal rush of current when the arrester discharges after a long period of idleness.

The rate of dissolution of the film depends upon the kind of electrolyte used and the temperature. There are two kinds of electrolyte made by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., one of which requires that the horns be bridged daily to pass current through the arresters, and the other which requires that the horns be bridged only every seventh day. The latter electrolyte has been known to stand without current for very long periods during cold weather, and when the horns were bridged no undue rush of current followed. However, in order to keep the films well built up, it is recommended that current be passed through this electrolyte every seventh day; this offers no inconvenience, as apparatus in general should be inspected at least this often.



Electrolytic Lightning Arresters

When arresters are bridged at normal voltage, a bluish, crackling static arc indicates the normal condition of the arrester. If the arc is reddish and fluffy, and rises high on the horns, it is evident that the bridging of the horns has been deferred too long a time, and it will take a short period before the arc comes down to normal.

The horn gaps and bridging device are mounted on a two-inch pipe frame, to which is also attached the transfer switch used for interchanging a ground and phase tank on ungrounded neutral arresters. The bridging device is very simple and can be operated from either end.

As the voltage increase the number of trays in the arrester also increases. Hence, for a higher voltage, if the trays were all built in a continuous structure, it would be awkward to handle and require considerable overhead room when installed indoors. For this reason, on all arresters above 13,200 volts, the Westinghouse tray structure is built

up into sections containing not over 50 trays, which slide into place, one above the other, between guides supported by a base casting fitting closely the bottom of the tank. Each section when filled with electrolyte can be easily handled without danger of upsetting it. The electrolyte is poured into the trays by means of a measuring cup, which contains the correct amount of liquid for each tray. When a section of trays is filled the electrolyte is plainly visible so that each tray can be checked.

All parts of the supporting frame directly in contact with the trays are made of the best grade of porcelain; hence, any danger due to burning supports, which is likely to be present in case wood is used, is entirely eliminated.

If, when the horn gaps are set to get the maximum protection from the arrester, a ground on one phase occurs, the horn gaps connected to the other phases will discharge until the line is cleared, or is thus subjected to a continuous discharge that may last a long time, the Westinghouse arresters are designed with large tanks holding sufficient oil to absorb the heat of a continuous discharge lasting over a considerable period.

The tanks are built large on the diameter so that the clearance between the top tray and tank where the maximum voltage exists provides a good insulation factor of safety.

NEW PACIFIC COAST REPRESENTATION FOR EASTERN MANUFACTURERS.

The Machinery & Supply Company, with offices at 61 Fremont street, San Francisco, have been appointed Pacific Coast representatives of a number of prominent Eastern manufacturers of power and mining machinery. A large stock for Pacific Coast buyers will be carried at the new Class A concrete warehouse being erected near Second and Bryant streets to facilitate quick delivery. Sales offices are also to be established in Los Angeles and Seattle.

This stock includes a complete line of heavy duty induction motors from the Ideal Electric & Mfg. Company of Mansfield, Ohio, power and filter presses from Wm. R. Perrin & Co., of Chicago, Ill., and Dick and Church boilers from the Phoenix Iron Works Co., of Meadville, Pa.

The Machinery & Supply Co., have been appointed exclusive Pacific Coast distributing agents for the Pittsburg Transformer Company and will carry a complete stock of this well known product. They are also agents for the oil furnaces, both metallurgical and forging, manufactured by the W. S. Rockwell Co. of New York City and for the electric meters manufactured by the Columbia Meter Co. of Indianapolis, Ind. Their representations further includes a complete line of "Solar" incandescent lamps.

The personnel of this new company includes Mr. R. B. Elder, formerly manager of the San Francisco office of the Allis-Chalmers Co., who has been appointed sales manager, and Mr. H. C. Wybro, formerly president of the Wybro Hendy Co., who will act as president. Connected with the staff also, are Mr. W. N. Dean, who has charge of the filter press department; Mr. A. E. Mason, formerly in charge of the furnaces and forge department of the Allis-Chalmers Co. at Milwaukee, Wis., who will handle the Rockwell line and Mr. George Boerschardt of the lamp department.

The entrance of this new firm into the industrial power field marks the welcome introduction of a number of Eastern manufacturers into the Pacific Coast market.

NEW CATOLOGUES.

Bulletin No. 431 from the Triumph Electric Company illustrates and describes Triumph alternating current generators.

Bulletin No. 1121 from the Fort Wayne Electric Works illustrates and describes the "Northern" type B direct current generators.

Bulletin No. 126 from The Electric Storage Battery Co. gives the details of a new type of oil insulator for supporting "Cloride Accumulator" cells in high voltage service.

The October number of The J.-M. Packing Expert from H. W. Johns-Manville Co. contains some excellent suggestions on boiler feed pump packing in addition to other interesting facts about J.-M. Packings.

Bulletin No. 10 from the Duncan Electric Company is devoted to the Duncan portable test watthour meter, containing a well illustrated and well written description of the operation and uses of this rotary standard.

Bulletin No. 125 from the Electric Storage Battery Company consists of a description of the installations of the "Chloride Accumulator" on the system of the Gulf Port and Mississippi Coast Traction Company.

Vitrified Fire Clay Conduit as manufactured by the Fire Clay Product Company of Brazil, Indiana, with offices in the Stock Exchange Building, Chicago, is well catalogued in a valuable pamphlet recently issued by the company.

Bulletin No. 1125 from the Fort Wayne Electric Works is devoted to the type K.3 Single Phase Induction Watthour Meter. Instruction book No. 3043 gives detailed directions regarding its installation, adjustment and connections.

Holophane Illumination for September, 1910, from the Holophane Company, illustrates and describes a new line of Holophane glass for residence lighting and contains some valuable hints upon the illumination of pictures, study rooms and drafting rooms.

Automatic Regulating Apparatus designed and manufactured by The Electric Storage Battery Co. is illustrated and described in their Bulletin No. 127. This includes the carbon regulator, adapted for controlling either a.c. or d.c. load fluctuation, and the recently developed average adjuster and current stop.

Portable Watthour Meter Calibrator, type K-M3, for alternating current, is illustrated by half tones and described by text, in Bulletin No. 1124 from the Fort Wayne Electric Works. This instrument eliminates the use of the stopwatch and allows of meter test under varying load from all ranges of service from light to full load.

The Engineering Department of the National Electric Lamp Association has just issued two Bulletins—one entitled "Mazda Multiple Lamps" (Bulletin 13) and the other "Hylo-Economical Turn-Down Electric Lamps" (Bulletin 14). Bulletin 13 contains practical information and technical data on Mazda Multiple Lamps for use on 100-125 volts and 200-250 volts. Bulletin 14 describes the turn-down lamp. The principle on which these lamps operate is fully explained and illustrated by means of diagrams.

TRADE NOTE

The General Electric Company will furnish to the Ray Consolidated Copper Company of Kelvin, Ariz., complete switchboard apparatus for the generating station, mill substation and mine sub-station. There will be 14 panels in the generating station to control four 2200 k.v.a. 6600 volt generators with five feeders—one for the station auxiliary, two for the mill substation, one for the pump station and one for the transformers to step up to 44,000 volts, for the mine sub-station, 20 miles away. In each of the sub-stations there will be a 10 panel board to control transformers stepping down from 6600 to 460 volts in the mill station and from 44,000 to 460 volts in the mine substation. The boards in each station are to control feeder circuits for induction motors; K-12 and K-6 hand operated oil switches will be used on 6600 and 44,000 volt circuits and K-2 switches will be used on 460 volt circuits.

NEWS NOTES

INCORPORATIONS.

BOISE, IDAHO.—The Raymond Telephone Company of Bear Lake county, capital $10,000, has been incorporated by Thos. M. Mumford and Geo. H. Hall.

HIGHLAND, CAL.—The Cleghorn Water Company has been incorporated by J. M. and L. D. Cleghorn and J. E. Williams with a capital stock of $20,000.

BILLINGS, MONT.—The Billings Traction Company, capital $100,000, has been incorporated by C. J. Eddy, J. W. Patterson and J. A. Connolly, all of Muskogee, Okla.

OROFINO, IDAHO.—The Orofino Electric Company, capital $25,000, has been incorporated to handle electric power plants and engage in manufacturing; incorporators are K. G. Osterhout, Theora Lister, J. H. Lister.

FINANCIAL

VALE, ORE.—The Council has passed an ordinance providing for holding an election to vote on issuing bonds in the sum of $35,000 to be used in installing a complete water system for the city.

OCEANSIDE, CAL.—It is expected that the $30,000 issue of 5 per cent bonds for the improvement of the municipal water plant soon to be put on the market, will bring a fair premium. The bonds will run 40 years and will be of $500 each.

SALEM, ORE.—The initial step toward the floating of bonds in the sum of $400,000 for the purchase of the plant of the Salem Water Company has been taken by the City Council. An ordinance calling an election will come up for final reading at the next council meeting.

VANCOUVER, WASH.—A special election is to be held on the 6th of December in the city of Vancouver, Clarke county, Wash., at which election shall be submitted the question as to whether or not the city shall borrow money in the sum of $314,000 to be used in furnishing and constructing a water system.

HELENA, MONT.—Plans and specifications for the new municipal water plant, submitted by City Engineer C. W. Halmick, have been adopted by the city council, and an election will be held January 10 to vote on the issuance of bonds in the sum of $650,000, bearing five per cent interest, for the purpose of installation of such system.

SAN FRANCISCO, CAL.—Bonds of the Los Angeles Railway Company will be redeemed with $142,378.58 now in the sinking fund of the company for that purpose, and bids are invited on or before November 10 for the surrender to this company of the 5 per cent mortgage bonds of the Los Angeles Railway Company to the extent of $142,378.58, at prices to be named by the bidders, but not to include a premium of more than 5 per cent on the par value of the bonds offered. All bids should be directed to I. W. Hellman, treasurer of the Los Angeles Railway Company, at his office in the Wells Fargo Nevada National Bank, San Francisco, and should state the lowest price which will be accepted for such bonds.

TRANSMISSION.

OROVILLE, CAL.—With the settlement of the suit brought by the Great Western Power Company against the various estates in this county, the power company has practically completed its rights of way for its second tower line of high tension wires from this city to Oakland. The company has been quietly engaged for the past year in buying rights of way for its double tower line.

PASADENA, CAL.—Pasadena is planning to build an extension at the municipal electric power house to accommodate the additional boiler soon to be installed and to make room for future extensions.

SEATTLE, WASH.—An auxiliary city power plant to be located on Lake Union will be built next year. It will be operated by water power and will supply 2000 additional h.p. to the city. A reservoir of about 200,000 cubic feet capacity will be built.

CARSON CITY, NEV.—The Brunswick mill site and power site, with water rights, has been taken over by the Western Smelters Corporation. A large reservoir will be built and a power plant built to supply power to the new smelter.

CENTRALIA, WASH.—It is announced that the Twin City Light & Traction Company has succeeded in raising $150,000 with which to build its proposed power plant. This company may lose its franchise here and the city may install a municipal lighting plant.

OROVILLE, WASH.—The North Washington Power & Reduction Company of Republic is circulating a petition through its local manager, asking that the city grant a franchise for the construction and maintenance of power and telephone lines within the city limits.

SPOKANE, WASH.—Walter Hovey Hill, consulting engineer for the United Placer Mines Co., which owns diggings at Lucile, 40 miles from Grangeville, Idaho, states that the company is planning on the installation of a hydroelectric plant with a capacity of 5000 horsepower.

MODESTO, CAL.—The Sierra and San Francisco Power Company is securing rights of way from the main power line at a point on the J. F. Miller land near Atlanta south through Ripon, Salida and southward toward Modesto. It is the plan of the company to reduce from 100,000 to 15,000 volts and carry the power southward on a pole line. There will be a line from the reducing station westward to the town of Menteca.

SEATTLE, Wash.—D. W. Ross, city electrical engineer, has designed plans for the proposed $60,000 2000-horsepower city auxiliary power plant to be located on Lake Union, which will be operated by water power. Construction work is to start early in the year. A 200,000 feet capacity reservoir will be built adjoining the present reservoir at Volunteer park, and a gravity system will be established from the reservoir to Lake Union to furnish the necessary water-power for the proposed plant.

LOS ANGELES, CAL.—An opening wedge into the discussion of the electric power problem of the Owens river aqueduct has been furnished by the Board of Public Works' announcement that it has agreed on behalf of the city of Los Angeles to supply the town of Independence, Inyo county, with aqueduct power. The dam is used to hold back the waters for the generation of power at the plant, which is one of the largest in the world. At the time the Western Pacific raised the levee system along Front street a track was laid on top of the levee and this gives the best transportation facilities from the plant.

SPOKANE, WASH.—Following the outcome of the litigation respecting the overflowed lands just below Coeur d'Alene, Idaho, where the Washington Water Power Company has its chief plant, the management is now planning a magnificent powerhouse at Nine-Mile Point. Extensive acreage has been bought up recently in the neighborhood, so that there

will be no likelihood of future damage suits ensuent upon the building of the necessary dam across the river. There is already a plant belonging to the Spokane & Inland Empire system at the same place, but the growing demands for power attendant upon the entry of new manufactures into the city, it is anticipated, will presently absorb an even greater extension of generated power than is at present contemplated.

SAN FRANCISCO, CAL.—U. S. Commissioner Harry M. Wright has recommended that the temporary injunction granted by the U. S. Circuit Court prohibiting the Hydro-electric Company from proceeding with the building of a pipe line across the Mono forest reserve be sustained.

KLAMATH FALLS, ORE.—The Klamath Falls Light & Water Company is making preparations to more than double its power at the Moore plant. An additional water wheel will be put in and still another in the spring. The plant will have 10,000 horsepower. The company will also do away with the wooden flume to the power wheel and will substitute iron pipe from the ditch to the plant.

TRANSPORTATION.

BELLINGHAM, WASH.—A survey is being made for a tram line from Senator Polson's mines to the B. B. & B. C. terminus.

PORTLAND, ORE.—Plans are under way to electrify the Southern Pacific line on the west side from Portland to Corvallis.

BELLINGHAM, WASH.—It is reported that arrangements have been made for building the Nooksack Valley Traction Company line from this place to Sumas.

SPOKANE, WASH.—The Spokane Traction Company will probably begin construction work on the extension of the N. Howard and Lincoln Heights lines respectively.

LOS ANGELES, CAL.—The City Council has passed an ordinance consenting to and accepting abandonment of a portion of a certain street railroad franchise granted to Wesley Clark on Park View street.

LOS ANGELES, CAL.—Property owners on Jefferson street between Main street and Central avenue have asked the Council to grant the Los Angeles Street Railway Company a franchise for a street railway on that portion of Jefferson street.

LOS ANGELES, CAL.—A petition is on file with the City Clerk asking the Council to advertise a franchise for sale through Broadway tunnel, so that Highland Park cars may reach Broadway, reducing the running schedule. The Los Angeles railway is willing to build the line if the franchise is offered for sale.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will build another club house for the use of linemen on the block at Hawthorne, Clay, Water and First streets. The building will be 100 by 200 feet, reinforced concrete, and will be used in part by the lighting department of the company.

VISALIA, CAL.—The Visalia Electric road has started work on the branch to Woodlake, and it will be finished by November. The branch, starting from the Bravo Lake station, will be three miles in length and will reach into the heart of the rich orange lands of that vicinity. The grading contract has been awarded to Buckman & Sons of this city.

ILLUMINATION.

OLYMPIA, WASH.—The Olympia Gas Company has authorized an issue of $1,000,000 in bonds for the purpose of enlarging its plant.

REDWOOD CITY, CAL.—The Redwood Gas & Electric Company has been granted permission to place gas mains in Hopkins avenue from Hudson to Cedar streets, Dingee Park.

FARMINGTON, N. M.—The Electric light plant has been purchased by a company headed by R. W. Kowles. They have signed a contract for enlargement and use of the Star ditch and will spend about $100,000 in improvements.

EUGENE, ORE.—Blue print plans for proposed changes to take place at the Springfield electric light plant this winter have been received by the Northwestern Corporation. The plant will be elarged to double its present size and a substation will be built. The increased plant will contain the new 2000 kilowatt turbine generator and two additional boilers with a capacity of 500 kw. each. The construction will soon begin. Machinery will arrive in January.

WATERWORKS.

TRACY, CAL.—A. T. Ames of Niles has been requested to furnish an estimate of cost of establishing a municipal water system here.

FULLERTON, CAL.—The Fullerton Domestic Water Company has been purchased by Tarber Montgomery. The new owner will make extensive improvements to the plant and mains.

LOS ANGELES, CAL.—A complete irrigation system of high pressure steel pipes, about 5 miles in length, equipped with one of the most econonmical and modern pumping plants is being built by Emil Firth in the Orange Cove tract.

LOS ANGELES, CAL.—T. S. Van Dyke is preparing to install a system of waterworks at Del Mar, for a syndicate of wealthy Los Angeles men which plans to make Del Mar one of the fashionable resorts of southern California.

LONG BEACH, CAL.—Initial steps have been taken by the City Council towards the installation of a high pressure water system in the business district for protection against fire. The estimated cost of this system is $113,080.88.

SAN FRANCISCO, CAL.—Sealed bids, in triplicate will be received until 11 a. m., October 28, at the office of the Constructing Quartermaster, Fort Mason, Cal., for furnishing and laying an 8-inch water supply main from the dock to the tanks at Ft. Baker, Cal.

MORGAN HILL, CAL.—Claiming that the water rates as set by the Board of Trustees of the town of Morgan Hill, Santa Clara county, are insufficient to pay the cost of operating its system, the Morgan Hill Water Company began suit in the U. S. Circuit Court Saturday to enjoin the Trustees from putting the rates into effect.

PORTLAND, ORE.—The Northwestern Engineering Corporation has prepared plans for a gravity pipe irrigating system for the town of Pasco, water to be supplied by the Pasco Reclamation Company from its plant on the Snake river. The town will also be supplied with a complete sewer system. The estimated cost of the improvements is $100,000.

SAN FRANCISCO, CAL.—Assistant U. S. Attorney Thos. E. Haven has completed his argument in the Spring Valley Water Company's water-rate case before U. S. District Judge E. S. Farrington. The counsel took the ground that the expenses of the water company's litigation with the city were not properly chargeable in the rates, and in support of his contention quoted from the decision of the California Supreme Court in the San Diego water cases, in which the expenses of the water company were decided not to be chargeable to the rates.